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THE SALMON FISHERY
OF
BRITISH COLUMBIA

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Honourable J. E. MICHAUD, M.P.,
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From King's Printer

The Salmon Fishery of British Columbia

In point of annual marketed return, the British Columbia salmon fishery is the most valuable of the fisheries of Canada. The return fluctuates from year to year, of course, but in 1936 it was \$13,400,000, in round figures. Some of the catch is marketed in the fresh or frozen form, some mild-cured, some smoked, some pickled, some dry-salted, but by far the greater part is canned. Three times since 1925 the year's output of canned salmon in British Columbia has exceeded 2,000,000 cases—forty-eight pounds of salmon to the case—and in 1930, when new records were set in the size of provincial salmon catch and salmon pack, more than 2,200,000 cases were put up. Some 70 per cent of the annual production of canned salmon is sent from British Columbia to export markets, going to something like thirty different countries, and canned salmon from the province is the largest single item, so far as value is concerned, in the Dominion's export trade in fish and fish products. In 1936, to take a recent year, the canned salmon exported from British Columbia to other lands was valued at more than \$6,350,000.

These are days of large-scale operations in the salmon industry, but commercial exploitation of British Columbia's great salmon resources goes back for more than one hundred years. The Hudson Bay Company was the first to prepare British Columbia salmon for the commercial market and until 1858, as pointed out in 1914 by F. W. Howay in his work, "British Columbia from the Earliest Times to the Present," the company claimed and exercised a monopoly of the salmon fishing on the Fraser river. Canning methods had not been evolved in those earlier days, but the company exported salted salmon to the Hawaiian islands and Asia, handling three or four thousand barrels of this commodity in 1835 and in each succeeding year for some time afterwards. In 1870 the first salmon cannery was built at Annieville, about three miles below New Westminster, by four pioneers in what was to become a great industry—David S. Hennessy and Alexander Loggie, who were natives of New Brunswick; Alexander Ewen, a Scotsman; and James Wise. At about the same time, a second cannery was built at New Westminster by a Captain Stamp. Progress in the salmon canning industry was slow for a time. The fishermen who caught the salmon and the cannery men who processed the catch had their share of difficulties. Gradually, however, the industry became well established and to-day some forty-five modern, efficient canning plants are in operation on the British Columbia coast every year, giving employment to about 4,000 cannery workers in the normal year, and pouring out a great stream of high-quality canned salmon which swells by many million dollars the total value of national production. In addition to the canneries, of course, there are also numbers of salmon-curing plants and salteries, while improved methods of storing and freezing fish have brought the salmon industry of the province large and increasing business in fresh and frozen fish.

FIVE SPECIES TAKEN

Five species of Pacific salmon (*Oncorhynchus*, or hooked snout) are taken by British Columbia fishermen. The fish are entirely distinct from the Atlantic salmon (*Salmo salar*) and the several species are known scientifically by names which came originally from the Russian vernacular. In everyday speech, of

course, they are known by names which come more easily to the tongue, the scientific names and the corresponding popular terms being as follows:—

<i>Oncorhynchus nerka</i>	Sockeye
<i>Oncorhynchus tshawytscha</i>	Spring
<i>Oncorhynchus kisutch</i>	Coho
<i>Oncorhynchus gorbusha</i>	Pink
<i>Oncorhynchus keta</i>	Chum

(The Steelhead and the Blueback are also taken in the British Columbia salmon fishery, but the British Columbia Blueback is a young Coho and the Steelhead does not belong to the genus *Oncorhynchus* but is *Salmo rivularis*.)

Though all members of the same family, the five species of British Columbia salmon differ somewhat in length of life span, in appearance, and in average weight at maturity. There is also some measure of difference in flesh composition. So far as protein content is concerned, the Pink comes first, with the Coho close in second place, and then the Sockeye, Chum, and Spring following in order. On the other hand, the Spring is first in fat content, with the Sockeye next, and then, in turn, the Coho, Pink, and Chum. Actually, however, the five species are all very similar in food value, although the rich, red colour of the Sockeye's flesh, and the firmness of its tissues, give this fish a market advantage and cause it to bring the highest price.

Difference in length of life cycle and in average mature weight are most marked in the case of the Pink and the Spring. The Pink lives only two years and its average weight at maturity is approximately four pounds, while the Spring may live six or seven years and reaches an average weight of about twenty pounds. The Sockeye's life span is four years, though sometimes five or six, and its average mature weight some five pounds. The Coho lives three years and its weight at maturity averages about six pounds. The Chum lives three years, or four, and, on the average, comes to weigh eight pounds.

All of these salmon are born in fresh water, but their mature life is spent in the sea; or, as the scientist would express it, they are anadromous. Whether they go far to sea, guided by instinct to some rich feeding ground, or whether they stay near the coast is a question which is still in doubt, but, wherever they are, when the spawning impulse comes upon them they turn their way unerringly toward a spawning ground in the river system where they themselves were spawned. Possibly they return to the very stream where they were spawned—that is a moot point—but, at all events, they go back to the same system where their own life began. It is when these migrations to the spawning grounds are in progress that the British Columbia fishermen make their great salmon catches. Year after year, when the migrations have begun, the fish swim along in their multitudes, in prime condition, their bodies stored with fat, and it is then that the troll, the gill net, the purse seine, the trap, and the drag seine reap harvest, though the Dominion Department of Fisheries, which administers the fisheries of the province, takes strict care so to regulate fishing operations that the salmon may reach the spawning streams of the province in numbers sufficient to ensure the maintenance of future runs.

Once started back to the spawning grounds from salt water the salmon take no thought of feeding. The stored-up body fat apparently suffices them. "The stomachs of migratory salmon are always practically empty and, indeed, even free from living bacteria" (*Clark and Clough*). Reaching the streams, the fish make their way against the current, mount rapids by their own efforts, or perhaps with the aid of fishways constructed and maintained by the Department of Fisheries, fight steadily onward, until finally they reach the spawning beds. Their store of fat has been used up, "partly in the long struggle against the current and partly in the formation of the eggs, which have been growing all the time during the journey." Gone, too, are some of the muscle protein and some of the flesh colouring, which, like the fat, have entered into the development of the eggs.

When the spawning grounds are reached, each female salmon, guarded meanwhile by the male, deposits her eggs to the number of several thousand in a little basin which the fish scrape out in the river bed with snout and fin. Then, when the eggs have been fertilized, the male and female fish join in covering them with gravel. With that, the life cycle of the parent fish is ended. Unlike the Atlantic salmon, the Pacific salmon spawns but once, and death follows spawning.

"The children never see their parents; one generation is dead before the next arrives. Thus, for a time, that particular 'run,' or family, is represented only by millions of eggs tucked loosely in the gravel of a thousand mountain streams. There they lie for some time, depending upon the temperature of the water, until a tiny fish begins to form in the egg, the first thing visible being the eye of the fish-to-be. Gradually, a backbone appears and then other characteristics until a tiny fish is formed and most of the egg material has been used for food and miraculously transformed into a living fish. Now the little ones emerge from the gravel and seek other foods. This is a dangerous time for them. Their enemies swarm about, and a large percentage fall victim to the avaricious birds, Dolly Varden trout, and other larger fish. Some escape, however, and learning from experience, become as wary and as agile as their enemies. Gradually descending the river, stopping for a while in favourable pools or lakes, they approach the ocean. Some go into the salt water when only a few months old, while others wait until in their second year, when they may be six inches or even larger in size. In the ocean they disappear and little is known of their life there . . . until they become mature, when they follow the path of their ancestors back to the stream from which they came." (*Clark and Clough.*)

MAINTAINING THE RUNS

Year after year, as has been said above, the salmon runs bring their millions on millions of fish. They constitute one of Canada's rich natural resources and their continued maintenance is a subject of prime importance to which the Department of Fisheries gives close attention. Conservation is effected both by prescribing the kinds of equipment which the fishermen may use, and the particular areas in which the different kinds of gear may be employed, and by enforcing "closed times" during the fishing seasons.

During the "closed times" no fishing is permitted and unhindered passage to the spawning grounds is thus kept open to the fish. The length of these "closed" periods is varied from time to time in different areas to meet whatever conditions may occur as regards the escapement of the salmon to the spawning beds, for there is a steadfast departmental insistence upon the rule that fishing operations must be so controlled that the maintenance of the runs is not jeopardized.

MAKING THE CATCH

In the operations of the salmon fishery drift gill nets are more generally used in British Columbia than any other device for catching the fish. Nevertheless, while gill nets are more generally used, the larger part of the annual salmon catch is made by means of purse seines. Other major devices used in catching the fish are the trolls and the traps. Use of the drag seine, or beach seine, is permitted to Indians only, and then nowhere except in certain specified areas. The drag seine, which is not more than 600 feet long, is fished from the shore at the mouth of a stream. One end is fastened to a stake on shore and, from a boat, the net is carried around a "school" of salmon until the second end has been brought back again to the starting point. A lead line, or sinker line, at the bottom and a cork or float line at the top keep the net suspended vertically in the water and as it is pulled shoreward the fish are entrapped.

Gill Nets.—As its name implies, the gill net is one with meshes of such size as will catch and hold the salmon by the gills, and it may run in length to 1,200 feet, the maximum permitted under the fisheries regulations for British Columbia. In drifting operations the net is paid out from the stern of the fisherman's boat and as a lead line carries the bottom downward a float line holds the top at the surface so that a vertical obstruction is suspended in the water and the fish are caught as the boat moves slowly forward. Gill nets are most frequently used in areas where the water is of such colour that it is difficult for the salmon to see the meshes in time to escape entanglement. Colouring of the nets is also often employed to add to their effectiveness.

Purse Seines.—The purse seine, which is from 900 to 1,200 feet in length, derives its name from the fact that it may be drawn into the form of a "purse" under water by means of ropes which run through iron rings fastened at its bottom. Purse seine fishing is done from power boats and the method of operation is, briefly, as follows: When the seiner sights a "school" of salmon one end of the net is put overboard and fastened to a buoy or stationary row boat; then, as the gas boat circles the "school," the crew pay out the seine over a roller at the stern; when the circle back to the starting point has been completed, a pull on the pursing ropes closes the bottom of the seine; the net is then gradually drawn to the surface at the side of the seiner's boat and the captured fish are dipped out and dropped into the boat's hold.

Trolling.—In trolling fishing is done with hook and line from a row boat or gas boat. Save for an occasional exception, only Springs, Cohoes, and Bluebacks are taken in trolling operations and a large part of the catch is disposed of in the fresh fish market. When the troller fishes from a motor boat as many as six lines will sometimes be used, some trailing directly from the stern of the boat, others being suspended from poles so adjusted as to project over the boat's sides. If the fishing is done from a row boat there is trolling by stern lines only. Baited plain hooks are sometimes used, but spoon hooks, baited or unbaited, are ordinarily employed, capitalizing the attraction which flashing metal has for the salmon. The "spoon," a piece of bright metal somewhat after the fashion of a large tablespoon, with hook attached, is suspended from the troll line in such a way that it twists or revolves in the water and by its flashes attracts the fish. The trolling lines may be twenty yards or more in length and the depth at which fishing is carried on is controlled by the size of lead sinkers employed.

Traps.—Pacific salmon traps are of two kinds, floating and stationary, but in British Columbia only the stationary trap is permitted, and this only in part of the strait of Juan de Fuca. The stationary trap is built out from shore in comparatively shallow water and is designed to take advantage of the fact that salmon will try to swim around an obstruction rather than turn back from their course. Since one end of the trap runs to the shore, the salmon must try to get around the outer or seaward end of the obstruction and in this effort they are caught in other parts of the device.

Traps may vary in minor details but their general plan is as follows: A "leader," made by driving long, heavy poles or piling into the bed of the water and fastening to these poles a fence of wire or net webbing, is built out from shore whatever distance may be necessary, perhaps nearly half a mile. At the outer end of the "leader" is the first of two "hearts" of net, fastened to piling. They are really enclosures with small entrances along the "leader." As the salmon strike the "leader" they turn seaward to get around it and are thus diverted into the "hearts" which are designed to collect and concentrate the fish. The second "heart" lies directly behind the first and is attached to it, serving largely as a safeguard against the escape of fish that have entered the first. Beyond the second "heart" is the "pot," the final unit of the trap proper,

and the fish, in a renewed effort to escape, find their way into it by means of a narrow "tunnel" from the "heart." This entrance is cleverly disguised from the inside of the "pot" and the fish cannot find their way out. In most traps there are also one or two square enclosures or "spillers" into which the fish may swim from the "pot."

When the time comes to remove the fish—"lifting" the trap is the fisherman's phrase—the "spiller" net is raised within a couple of feet of the top of the water, several men in a row boat enter the enclosure and gradually pull up the net, thus driving the fish into an end or pocket of the net. A "brailer," or large scoop of heavy netting, operated by power from a fish tender or tugboat alongside, dips out the salmon and drops them into a scow. When the trap has thus been emptied, as is done once a day, or once every other day, the tender tows the scow to the cannery or salmon curing plant and there the fish are prepared for market.

METHOD OF CANNING

Salmon canning operations were formerly carried on almost entirely by means of hand labour, but to-day that condition has largely disappeared and a British Columbia salmon cannery is a plant where ingenious machinery operates with wonderful efficiency and swiftness. The fisherman's boat or the carrying scow brings the fish to the cannery, where they are unloaded into bins, which are kept clean by means of frequent streams of water; then the machine comes into play, and a comparatively short time later piles of finished cans of salmon are ready to be boxed in cases for shipment to market centres.

As canning begins, fish from the bins are fed to a machine which, automatically adjusting itself to the varying sizes of fish as they come along, grips each salmon, cuts off head and tail and all six fins, splits the body, and ejects the viscera, and completes that job at the rate of one fish a second! From this machine each body drops to a belt conveyer—the waste being carried off by another conveyer, sometimes for use in making fish meal and oil—and as it is borne along it is washed by continuous streams of clear cold water and is inspected by one of the workers known as "washers." If, by chance, any of the fish have not been thoroughly cleaned by the streams of water the "washers" lift them from the conveyer and clean them by hand. At a certain point on the conveyer, in most plants, the fish reach an elevating device which forces them up through a gang of revolving knives, which cuts them into pieces of suitable size for the cans. Where brine salting methods are followed, the fish fall from the "gang knives" into a brine tank, and this is the plan which usually prevails in canneries where cans are filled by hand. Where cans are filled automatically by machinery—the method of operation now in use in most instances—the fish, on dropping from the "gang knives," fall into a bin which inclines toward the filling section. At this point a stream of cans rolls continuously down a runway and as the streams of fish and cans converge the filling machine packs the cans, and a uniform quality of salt is added by the salting device. In some plants the "gang knives" are not used, but the filling machine both cuts and packs the fish. The rate at which cans are filled by the machine usually ranges from about sixty to eighty cans a minute, although in some canneries there is considerably higher speed.

From the filling section the cans are carried along by the conveyer to pass before expert examiners who remove any which have been improperly packed. An automatic device weighs each can as it comes along, ejecting at one side of the conveyer any can which is under weight, and the necessary additional quantity of fish is packed in on top. From the examiners the cans move along the conveyer to the clinching machine which feeds a steady stream of covers and clamps them loosely on the cans.

In some canneries the cans next pass into a steam box where the heat, penetrating the can, causes expansion of the water content of the fish so that on cooling there will be a vacuum. In other plants the steam box has now been replaced by "vacuum closing machines" which admit the cans through airports to chambers from which most of the air has been pumped, and there the covers are fastened down tightly. When the steam-box method is used the cans are carried in endless procession by mechanical conveyers, being kept for from five to fifteen minutes at a temperature of about 212° Fahrenheit. The vacuum or partial vacuum produced by either of these methods keeps the ends of the cans collapsed, reduces the strain on the sealed cans in the subsequent cooking processes, and checks the growth of micro-organisms. Either method of producing the vacuum is satisfactory, but the vacuum machines take up much less space than the steam-boxes, and they are looked upon by many canners as having other advantages as well.

After the covers have been sealed on tightly, either in the course of "vacuum closing machine" operations or by means of a closing machine where the steam-box method of creating a vacuum is used, the cans are placed on large iron trays which are then stacked one above the other on low trucks or cars. Several of these laden trucks, carrying in all a great number of cans, are pushed along a narrow track into a big iron retort or oven, the door of the oven is closely fastened, and steam is turned on within until a temperature of 240° Fahrenheit is reached. The cans are kept in this temperature for from eighty to one hundred minutes so that the contents are thoroughly cooked and destruction of all bacteria which might otherwise affect the product is ensured. Then the oven is opened, the cans are taken out, washed, and allowed to cool and dry. In nearly all British Columbia plants they are also lacquered. Labelling is done by special labelling machines and the cans are then placed in the shipping cases for transportation to market. Each case contains either forty-eight one-pound cans or ninety-six half-pound cans; but official statistical records showing the pack always express the production in terms of the forty-eight pound case.

OTHER PROCESSING METHODS

Although canning far exceeds in importance any other processing operations in the salmon industry of British Columbia, the combined outputs of dry-salted, mild-cured, smoked and pickled salmon make up a fairly large total. Of late years this total has been fifteen or sixteen million pounds annually, with the output of the dry-salted commodity making up the greater part. Spring and Coho salmon are used for mild curing, smoking, and pickling, and Chums for dry-salting. Pinks are also used occasionally for dry-salting, while the Indians produce some smoked Chums for their own use.

The methods of producing these varieties of prepared salmon are all comparatively simple. It should be kept in mind, however, that this bulletin is not intended to give a complete, technical description of salmon processing methods and the outline of dry-salting and other operations is general only.

In dry-salting the salmon are split to the throat and cleaned, and then are heavily salted. All save a small part of the annual British Columbia production of dry-salted salmon is exported to Japan. Most of the mild-cured salmon is also exported, Germany being one of the larger buyers. In mild-curing operations each fish is split in two down the middle, the head, tail, and all fins except the pectorals are cut off, and the backbone is removed. The sections of fish are scraped clean with knives and brushes and are then placed in bins or vats for cooling. After they have been thoroughly cooled, whether by means of streams of cold running water or by the use of ice, they are salted down in tierces for shipment. They are given only a slight salting, hence the term

"mild cured." Fish prepared in this way are much used by salmon smokers, who "wash them for a few minutes and then have practically a fresh fish to smoke."

When salmon are to be used for pickling the heads are cut off, the fish are split along the belly and cleaned, and most of the backbone is taken out. After the fish have been thoroughly washed in cold water they are placed in large containers and about fifteen pounds of salt to every hundred pounds of salmon are added. The fish are left in the salt for about a week and then they are removed, rubbed clean by means of brushes, and placed in casks for shipment. Additional salt is put on the fish when they are being packed.

Salmon smoking is done simply by exposing to the smoke and heat of wood fires fish which have previously been pickled. The fish are hung in smoke-houses and first remain over a fairly hot fire for a number of hours, usually about two days. Their exposure to the smoke from a smouldering fire for approximately three days more completes the process, and they are then packed in boxes for transport to market.

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